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Communications network

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Communications network

In one aspect, the present invention relates in general to a communications network, allowing data or speech, or both, to be transferred between users. Such network comprises user equipment, network entry and exit points communicating with user equipment, network nodes communicating with each other and with network entry and exit points, etc. Networks of this type are known in the form of, for instance, a telephone network (e.g. GSM), the Internet, etc.

One major disadvantage of such known networks is the complexity and costs of the network components, such as for instance a GSM antenna or an internet router. A GSM antenna typically is quite bulky, and needs to be placed at a high location, and placement is subject to permission from competent authorities. Therefore, providing network facilities to, for instance, a newly developed residential area, or improving network facilities for such area, may in practice take quite some time.

Thus, it is one objective of the present invention to provide low cost and fast communication equipment, having a large bandwidth, with which a communications network is quickly to install.

In another aspect, the present invention relates to a communication network which is capable of being used in a positioning system. Such communication network typically comprises data transmission equipment having an accurately known location, capable of sending data to a receiver. The receiver receives data from at least two, preferably at least three of such senders, and is capable of calculating its own location on the basis of the time differences between the received signals.

Such positioning system is known per se. Specifically, the global positioning system (GPS) is known, which requires satellite senders in orbit around the earth, which makes such system very expensive.

An important field of application for a positioning system is the field of car navigation systems. In such car navigation systems, the driver of a car (or other type of vehicle) receives directional instructions after having entered his destination. In such system, it is of course important to know the present location of the car with a sufficient accuracy. Present day navigation systems use the GPS system, sometimes supplemented by speed sensors etc.

In this aspect, it is an objective of the present invention to provide for a fine-mazed and relatively low-cost positioning system.

In a third aspect, the present invention relates to an illumination system. This aspect will be specifically explained in the context of street lighting, but this aspect is also applicable inside buildings, for offices, houses, etc.

Street lighting comprises a plurality of light sources, typically lamps arranged in armatures placed on lamp posts. The light sources are connected to power supply cables, which connect to a centrally controlled power station.

In order to save costs, it is very desirable to be able to reduce power consumption of street lighting, for instance by dimming or switching off individually selected lamps during certain periods when little or no traffic is expected. In ordinary street lighting, this is not possible, or only at high costs. The lamps can only be switched on or off, by applying power to the power supply cables or disconnecting the power supply cables, respectively. Thus, the street lighting can only be switched on/off as a group, i.e. as an entire street or area, or even as an entire village. Dimming would be feasible, by applying reduced power to the power supply cables. In practice, street illumination is reduced during night time by having a set of two power supply cables, one for the lamps that should remain ON during night and one for the lamps that should be switched OFF during night, so that, also in this case, switching ON and OFF is executed by applying power to the cables. If it is desired to change the behavior of one lamp, it must be manually connected to another power supply cable.

In this aspect, it is an objective of the present invention to provide for a street illumination system wherein individual lamps can be easily switched ON or OFF, at relatively low cost.

In a fourth aspect, the present invention relates to a lamp. Different types of lamps are commonly known, for use in domestic surroundings, street lighting, etc. Different types of lamps include, for instance, fluorescent lamps, glow lamps, etc. In all of these cases,

the lamp is an element that is exchangeable, having a lamp fitting which fits into a lamp socket of a lamp armature.

Up till now, lamps are only used for their function as light generating element. In this aspect, a further objective of the present invention is to expand the functionality of lamps.

According to an important aspect of the present invention, a lamp is provided with a small network element, which may be arranged within the glass envelope of the lamp but which preferably is arranged within the lamp fitting.

Preferably, the network element is provided with a switching facility, for switching the lamp ON or OFF in response to a corresponding command. Thus, the power cables may be live at all times, providing supply power to the network element, while individual lamps may be switched ON or OFF as desired.

Preferably, the network element is provided with a dimming facility, for dimming the lamp in response to a corresponding command. Thus, individual lamps may be dimmed as desired.

It is highly advantageous to implement the invention in a lamp intended for street lighting. Nowadays, street lighting is standard available in populated areas, especially in residential areas, office areas, etc, and also in many roads and highways between such areas. The lamps need to be replaced anyway once every 3 to 5 years. If it is desired to profit from the advantages offered by the present invention, it suffices to replace the present lamps by lamps according to the present invention. Of course, it is also possible to use lamps according to the present invention for newly arranged lamp armatures. In any case, it is not necessary to make amendments to armatures and the like: lamps designed in accordance with the present invention can be placed in existing armatures.

After such replacement, the economical advantages of the invention are immediately available to the authorities managing the street lighting. Also, in the areas where the lamps according to the present invention are used, a high-capacity communication network and a fine-mazed positioning system are made available. The costs of this functionality are relatively low. Basically, these costs consist in the costs of the small network element added to the lamp, which costs are at least partly compensated by the cost savings potentially offered by the individual dimming and switching functionality now implemented in the lamp.

These and other aspects, features and advantages of the present invention will be further explained by the following description of the present invention with reference to the drawings, in which same reference numerals indicate same or similar parts, and in which:

Fig. 1 schematically shows a cross-section of a lamp;

Fig. 2 schematically shows a block diagram of a network element;

Fig. 3 schematically illustrates a communication network formed by network elements of the present invention;

Fig. 4 schematically illustrates a positioning system formed by network elements of the present invention.

Fig. 1 schematically shows a cross-section of a lamp 1, in this case a glow lamp, comprising a glass envelope (or bulb) 2 inside which a glow spiral 3 is supported by conductive spiral supports 4. The lamp 1 further comprises a fitting 5, in this case a screw type fitting, for screwing into a standard lamp socket (not shown for sake of simplicity). As is normal, the screw thread is made from a conductive material to act as one electrical contact, while a central solder pad 6 on the axial face of the fitting 5 acts as second electrical contact.

Normally, the fitting 5 is fixed to the bulb 2 by cementing, in which case the interior of the fitting 5 is substantially filled with cement. In this case, the lamp 1 comprises a network element 10 arranged inside the fitting 5.

Alternatively, the network element 10 might be arranged inside the bulb 2. Such embodiment will offer the same or similar advantages. However, it is preferred that the network element 10 is arranged outside the bulb 2 inside the fitting 5, because such location is easier to handle during manufacture and does not affect the production process of lamp bulbs.

Fig. 2 schematically shows a block diagram of the network element 10. Electrical inputs 11 and 12 of the network element 10 are electrically connected to lamp contacts 5 and 6, for receiving supply power when the lamp 1 is mounted in a lamp socket. Electrical outputs 13 and 14 of the network element 10 are electrically connected to the supports 4 of the glow spiral 3. A voltage converter 15 or the like has its inputs connected to the electrical inputs 11 and 12 of the network element 10, thus receiving the supply power. The voltage converter 15 is designed to generate an adequate output supply voltage for a

control unit 16, which may comprise a suitably programmed microprocessor or the like. The control unit 16 generates a control signal to a power switch 17, which has its inputs connected to the electrical inputs 11 and 12 of the network element 10, thus receiving the supply power. At its outputs, which are connected to the electrical outputs 13 and 14 of the network element 10, the power switch 17 provides power for the glow spiral 3, depending on the control signal received from the control unit 16.

The control unit 16 is designed to generate its output control signal in response to an input command signal, which may be transferred over the power cables and received at power input 11, 12, but which preferably is transferred by other means, as will be discussed later. Depending on such command signal, said output control signal may switch the power switch 17 to an active state (lamp ON) or inactive state (lamp OFF). The output control signal may also switch the power switch 17 to a dim state, controlling the dim level in the range between 0% (lamp OFF) and 100% (lamp full ON).

It is noted that embodiments are possible where the possibility of switching and dimming the lamp 1 are omitted; in such case, the power switch 17 may be omitted, and the spiral supports 4 may be connected to the electrical lamp contacts 5, 6 directly.

According to an important feature of the present invention, the control unit 16 is capable of communicating wirelessly with its surroundings.

In one embodiment, the element 10 may be provided with a separate antenna (not shown). It is even possible that a special armature (not shown) is provided, with special arrangements for wireless communication. However, in a preferred embodiment advantage is taken of the fact that the glow spiral 3 and/or one or more of the spiral supports 4 can act as a transceiver antenna. Therefore, in the embodiment of Fig. 2, an input/output terminal 18 of the control unit 16 is connected to an electrical output 13 of the network element 10 via an antenna line 19.

If desired, it is possible that the shape of the glow spiral 3 and/or one or more of the spiral supports 4 are optimized for antenna operation in a certain frequency band or a plurality of frequency bands, as will be known to persons skilled in the art, without affecting lamp operation.

According to an important feature of the present invention, the network element 10 has an individual IP address, and is equipped with router technology, allowing the network element 10 to communicate with neighboring elements and with end users. Thus, when mounted in street lighting posts, the lamps 1 (or better: their network elements 10) constitute nodes in a fine-mazed communication network.

Fig. 3 is a diagram illustrating this network. In a residential area, light posts 20 are arranged at predetermined locations, usually regularly spaced, at distances typically in the order of 25 meters. At its top, which is typically at a level in the order of 6 meters above ground level, the lamp posts 20 carry at least one armature with at least one lamp 1 in accordance with the present invention. Independent of the fact whether the lamps are ON or OFF, the network elements 10 of the lamps 1 are capable of communicating with each other such as to transfer information; these communication paths are shown in Fig. 3 at 21. These communication paths 21 may comprise RF communication links or (free space) optical links. By implementing the communication paths 21 in the form of free space optical links a relatively high bandwidth can be achieved. For this purpose relatively cheap standard optical components, such as already used in CDRW-drives, can also be used in the network elements 10. Standard modulation techniques, driver circuits, lasers and optical pickup components can be used. Preferably, the optical components and circuitry in the network elements 10 are adjustable so that the free space optical links can be adjusted or realigned on the fly. If some aspect or component of the optical link needs to be adjusted, e.g. for focusing purposes, a relatively slow RF feedback information link may be used to transfer feedback information between the network elements 10.

By realigning the free space optics in the network elements 10 a new network architecture can be defined. Positioning information with respect to the position of the network element 10 to which a free space optical link is to be established is needed in order for the originating network element 10 to align and set up the desired link. GPS positioning information may be used for performing a coarse alignment towards the desired network element 10. Fine alignment can be done by using the GPS timing information in both network elements 10 simultaneously in a phase-locked loop configuration to increase the signal-to-noise ratio.

Houses 30 in this residential area may also be provided with one or more network communication elements (not shown), capable of communicating with the network elements 10; these communication paths are shown in Fig. 3 at 31. Therefore, it is possible that a communication path is established between any combination of two of such houses in said residential area, for instance as telephone function or baby phone function. It is also possible that video or audio signals are communicated to a house in this area.

At one or more locations, a high-capacity antenna 40 may be arranged, linking (shown at 51) to an internet router 50 for high-speed internet communication over a larger distance. This antenna 40 may communicate (shown at 41) to one or more of the network

elements 10. Since all network elements 10 may communicate with each other, either directly or through the intermediary of one or more other network elements 10, such antenna 40 is available to all houses 30 in said area, even if the distance from such antenna 40 to a specific house 30 is relatively large. Thus, effectively, each house 30 now has access to the Internet via a high-speed channel (31-21-41-51), at relatively low costs.

Alternatively, instead of such antenna 40, a wired access point (not shown) may be available, arranged on top of a high building, communicating on the one hand to one or more of the network elements 10, and on the other hand linking to an internet router.

The network elements 10 can operate as access point for the houses 30, as mentioned, but also as access points for mobile applications, such as for instance a mobile telephone 60, a car 70 or car phone, a lap top computer provided with modem, etc.

Apart from constituting a communication network, the network elements 10 of the present invention also allow for a relatively low cost implementation of a positioning system, as will be explained with reference to Fig. 4. A mobile positioning device 80, which may be a device on board a moving vehicle 70, or which may be a hand-held device, is capable of communicating with at least two of the network elements 10 inside the lamps 1 mounted in respective lamp posts 20. At a certain moment in time, for instance triggered by a central unit, or at fixed times, the two network elements 10 transmit a signal, each signal including a code identifying the corresponding network element, and therefore representing the location of origin of the transmitted signals since the locations of the lamp posts are fixed and known. Alternatively, instead of or in addition to a code identifying the corresponding network element the signals may comprise location information pertaining to the location of the corresponding network element and/or lamp post. From the time difference between arrival times of these signals, and the locations of origin of the signals, the positioning device 80 is capable of calculating quite accurately its position with respect to the lamp posts 20, and from that it can calculate its absolute location.

As compared to the GPS system, which uses earth-orbit satellites, a relatively high accuracy is obtained at relatively low cost. Even if the positioning device takes into account only the signal from one transmitter, i.e. the signal from the closest network element, the positioning device is able to estimate its location with an accuracy in the order of 10 meters, namely within a range of about this radius from the location of the lamp post from which the signal originates. Taking into account the signal from the closest two transmitters will improve the accuracy to an order of better than 1 meter, especially if the arrival time difference is taken into account.

In order to determine the position of each network element and/or lamp post and/or armature, the network element, lam post or armature may comprise a GPS receiver. Standard GSP receivers can deliver their position with an accuracy of approximately 10 meters. In order to improve this accuracy the GPS receiver may be complemented with audio and optical sensors the information of which is used for calibration purposes. An example of this is shown in Fig. 5. On the left side a top-inside-view is given of one of the armatures as installed in the scene on the right side of the plot. The parts in the armature (E) are an audio sensing device, for example a microphone (A), an audio emitting device, for example a loudspeaker or piezo element (B), a cheap GPS receiver (C), a bidirectional free space optical link, for example a laser and pin diode combination (D) and a passive retro reflector (F).The low cost GPS receiver gives the position with an accuracy of about 10 meters. In this way the position of the street poles (or lamp posts) are known within that accuracy. To enhance the accuracy an optical measurement can be performed with an accuracy of 1 mm between those poles, which have visual contact by using the free space optical links. For the poles, which have no visual contact, an audio measurement with the audio emitter and sensor can be performed by measuring the delay of that audio signal between the poles. After the network has obtained the exact distances between the poles, this information can be combined and optimized with the GPS outcome of each individual GPS receiver. In this way it is possible to calculate the position of each pole in a very accurate and flexible way with extremely cheap hardware.

Such positioning system is one example of a system where communication in the sense of data transfer from the lamp to a receiver is involved. Other examples are, for instance, a traffic information system, a car navigation system, an audio and/or video distribution system, a guided tour system, etc. The system may be complemented by AM or FM radio transmitters in the lamp posts or armatures to transmit local AM or FM signals (which may also include RDS information) with a very limited range. These local AM or FM signals can then be received by standard AM or FM receivers which are available in almost every car. In this way, and by using the position information of the car as determined by the positioning system, localized audio can be provided, e.g. specific audio for every car.

The street lamps or lamp posts may comprise an optical indicator which is capable of emitting light in different colors. Every color has a certain meaning and/or purpose which should be clear to the people. For instance, when the light is red it could mean that an ambulance or police vehicle or a fire department vehicle will pass here soon (in a great hurry). Yet another color could indicate that you are approaching a traffic jam or that

the road is slippery. In this way, the people are warned in advance of an upcoming dangerous situation. The optical indicator is controlled by the network element 10 on basis of information received by the network element 10 from the network or on basis of sensor information (such as from temperature sensors in or near the road).

The street lamps or lamp posts may comprise a RFID tag reader for reading and/or tracking RFID tags or IEEE 802.11b send-only devices. Such RFID tags may be comprised in clothing or shoes of individuals and the system may be used to track these individuals during large-scale sporting events (such as a marathon) or for personalized sports training programs. Stolen goods comprising a RFID tag or an IEEE 802.11b send-only device can be tracked and followed by the system and the police or security people can be warned by the system.

The system according to the present invention may also be advantageously used to supply/replenish (battery) power/energy for personal electronics (such as PDAs, mobile phones, MP3 players etc.) and wearable electronics. Permissions and charging are negotiated ubiquitously via wireless links to the network elements 10. Power can be supplied via conventional cable or via wireless beaming using remote power technologies such as rectenna. Alternatively, the system may be used to charge a car battery and/or to keep the car defrosted (during wintertime).

The street lamps or lamp posts may comprise a camera which camera can be used for monitoring traffic conditions (for instance a car crash can be detected and the local traffic can be rerouted), for monitoring the number of open parking spots and routing the cars to the nearest available free parking spots, for monitoring traffic patterns at crossroads for use by the traffic light controller, for reading number plates, for monitoring and registering cars that do not stop for red traffic lights or that have a too high velocity, for monitoring and registering (potential) criminal activity.

The street lamps or lamp posts may comprise a sensor unit with sensors for sensing temperature, pressure, humidity, water/rain, wind, light, acceleration, fog and/or smoke. In this way the local weather and seismological conditions can be determined. By incorporating these sensor units in a network such as the network according to the present invention a distributed seismological and weather station can be created. The need for local weather information increases, especially in the case there is local fog. Incoming traffic could be warned when the sensors detect fog or other potentially dangerous weather conditions. Wireless communications between the cars and the network opens the possibility to incorporate information from even more sensing devices. For example, information from the

car's temperature and rain sensors can be combined with the information from the sensor units in the street lamps or lamp posts. This information can be combined within the cars or in the network. With the combined information the cars are able to better decide whether to activate the windscreen wipers.

The street lamps or lamp posts may comprise one or more microphones for picking up sounds of the environment. In this way, certain events that produce characteristic audio patterns can be detected. Examples of such events are traffic accidents, speeding cars, explosions etc. This detection can be done in an audio signal processor in the street lamps or lamp posts itself or alternatively in a central node within or connected to the network to which all the picked up sounds are transmitted (via RF or optical link). The audio signal processor may be embodied so as to store the audio signal pertaining to the detected event. The audio signal processor may be embodied so as to store the exact date and time of the detected event. In the audio signal processor the exact position of the event can be determined and stored by combining audio signals from different nodes (e.g. street lamps or lamp posts). The information stored by the system can be used for insurance companies and/or court cases pertaining to the detected event. The system may be arranged for alarming the fire department, the police and/or the hospital in dependence on the detected event.

The street lamps or lamp posts may comprise a pointing device such as a laser for pointing a beam of light or other electromagnetic radiation towards one or more special areas on the road. The pointing device is capable of "drawing" any Fig. or text on the road. In this way, traffic signs or advertisements can be displayed on the road. By making use of electrowetting techniques or rotating mirrors or actuators such as used in conventional CD-players the direction of the beam can be altered. The special areas on the surface of the road may comprise phosphors or may even be a structure having little surfaces pointing to the incoming traffic. In this way the system can even be used in daylight. This system enables dynamic road marking, signaling in case of emergency deviations, police car warning, route assistance, driver dependent warnings (e.g. informing the driver of a too low tire pressure or of the fact that he or she forgot to switch off the lights).

The communications network according to the present invention can advantageously be used to communicate with communication terminals that are positioned near bus stops and that provide accurate information with respect to the arrival time of the next bus, the number of free seats in the next bus etc. The communication terminals may also be used to pay for a bus ticket in advance. The communication terminals may have a touch screen display. It is also possible to create dynamic bus stops because the position of the

busses is known by the system (provided that the busses comprise a positioning device 80). Experience in route delays can be used to calculate the estimated time of arrival at a certain spot. Once a customer asks for transportation (e.g. by means of the above mentioned communication terminals) a new route can be calculated for a certain bus. A dynamic bus stop can be determined on a safe spot nearby. The customer can be directed to this nearby spot.

In order to increase the security of communications between a multi-node mesh network, such as the communications network according to the present invention, a multi-path link structure between the user node and the network nodes may be provided. In Fig. 6 an internet backbone connection provides data back and forth to the nodes of a mesh network. Nodes of the network are equipped with programmable communications circuits, such as WiFi integrated circuits. The users terminal requests secure communications service from this mesh network. The WiFi chips form a multi-path routing architecture so that the data from the user and the internet is exchanged in a coded fashion using these multi-path architecture. The users terminal might even appear like many random terminals to an external intruder due to the frequency bands and time slots used for the communications, plus varying local (proxy) IP number assignments. As the user moves around, the synchronization can be achieved only at the real user locations, and elsewhere the full data looks like noise.

Fig. 7 illustrates a number of possible appearances of different packets. As shown, the packets can either be interleaved or overlapping in time (or frequency) according to the user's wishes. This can also be implemented to follow the user's motion with a given accuracy. The packets may contain either the actual (not-encrypted) data, or encrypted data from which the actual data can be deciphered by means of simple operations between the signals coming from different paths. Although, Fig. 7 indicates full IP packets, the same principle can also be applied to individual physical layer signals such as 2.4 GHz RF or impulses in ultra-wide-band (UWB) communications. In this case, however, the synchronization of the signals has to be made especially accurate (sub-nano second in time accuracy, or about 10 cm accuracy with respect to the user's position). Of course, with this difficulty, which can be solved with proper (WiFi, or UWB) chip design in the nodes, an improved security is obtained.

The lamp according to the present invention is very useful in such applications, when the control unit 16 of the network element 10 is designed to modulate the lamp current. Consequently, the light produced by the lamp is modulated accordingly, at frequencies high enough such as to be undetectable to the human eye. However, a small and

cheap detector (light sensor, for instance infrared sensor) would suffice for receiving the information transmitted by the lamp in the form of "encoded" light. For example, by modulating the lamp current of a street lamp that is emitting about 5% infrared light it is possible to provide people and/or cars or the like with information such as street names (which are sometimes difficult to find or to read). The bandwidth of such communications may be about 300 kilobit per second.

In street lighting, the costs of managing and maintenance are an important factor. Regular inspection of the lamps is necessary in order to recognize potentially problematic situations before they lead to failure of a lamp. Such inspection, up till now, involves visual inspection of each lamp site by maintenance personnel, which is very time consuming and labor intensive, hence expensive.

This problem can be overcome with lamps in accordance with the present invention, as illustrated in Fig. 2. The lamp 1 comprises at least one sensor 90 for measuring at least one parameter relevant to the operation of the lamp, for instance a temperature sensor. At any desired moment, maintenance personnel can, from any location where a connection to the Internet is possible, or at least from any location where direct or indirect connection to the network element 10 is possible, address the individual network element 10 associated with this specific lamp, and send a status update command. In response, the network element 10 will send a measuring signal corresponding to the sensor reading. Thus, the maintenance personnel has available important information on operational parameters of the lamp, and may decide, on the basis of this information, whether or not a maintenance visit to this lamp is necessary.

Also, it is possible that the control unit 16 is designed to monitor the sensor 90 readings, and compare them with predetermined reference values to detect possible abnormalities, in which case the control unit 16 is designed to send a message, through the network established by the network elements, to a central maintenance post (not shown), so that maintenance personnel may go and inspect the corresponding lamp.

It should be clear to a person skilled in the art that the present invention is not limited to the exemplary embodiments discussed above, but that various variations and modifications are possible within the protective scope of the invention as defined in the appending claims.

In the above, the present invention has been explained with reference to block diagrams, which illustrate functional blocks of the device according to the present invention. It is to be understood that one or more of these functional blocks may be implemented in

hardware, where the function of such functional block is performed by individual hardware components, but it is also possible that one or more of these functional blocks are implemented in software, so that the function of such functional block is performed by one or more program lines of a computer program or a programmable device such as a microprocessor, microcontroller, etc.

CLAIMS:

1. Lamp (1), provided with a network element (10).

2. Lamp according to claim 1, comprising:
- an at least partially transparent envelope (2);
- a fitting (5) fixed to said envelope (2), adapted for connecting the lamp electrically and/or mechanically to a lamp socket;
- wherein said network element (10) is arranged inside the fitting (5) outside the envelope (2).

3. Lamp according to claim 1, wherein said network element (10) is capable of communicating wirelessly with its surroundings, said network element (10) preferably being capable of communicating wirelessly with another network element (10) of another lamp according to claim 1.

4. Lamp according to claim 3, further comprising a spiral (3) and a spiral support (4), wherein said spiral (3) and/or said spiral support (4) are adapted to be able to act as a transceiver antenna.

5. Lamp according to claim 1, wherein said network element (10) has an individual IP address and is equipped with router technology.

6. Lamp according to claim 1, intended for use in street lighting.

7. Lamp according to claim 1, wherein the network element (10) is provided with a switching facility, for switching the lamp ON or OFF in response to receiving a corresponding command.

8. Lamp according to claim 1, wherein the network element (10) is provided with a dimming facility, for dimming the lamp in response to receiving a corresponding command.

9. Lamp according to claim 1, wherein the network element (10) is provided with a modulation facility, for modulating the lamp current such as to modulate the intensity of the light emitted by the lamp, in order to transmit information in the light domain, for instance in the infrared domain.

10. Lamp according to claim 1, wherein the network element (10) has electrical inputs (11, 12) connected to electrical contacts (5, 6) of the lamp, and a control unit (16) receiving supply voltage derived from the input voltage received at said electrical inputs (11, 12).

11. Lamp according to claim 10, further comprising a spiral (3) and a spiral support (4), wherein said control unit (16) has in input/output terminal (18) coupled to at least one of said spiral (3) and/or said spiral support (4).

12. Lamp according to claim 10, wherein the network element (10) has electrical outputs (13, 14) connected to a light generating element (3) of said lamp;

the network element (10) further comprising a controllable power switch (17) having inputs connected to said electrical inputs (11, 12) and having outputs connected to said element outputs (13, 14);

wherein the power switch (17) has a control input coupled to a control output of said control unit (16).

13. Lamp according to claim 12, wherein the said control unit (16) is capable of switching said power switch (17) to an active state (lamp ON) or inactive state (lamp OFF) in response to receiving a switch command signal.

14. Lamp according to claim 12, wherein the said control unit (16) is capable of switching said power switch (17) to a dim state, controlling the dim level in the range between 0% (lamp OFF) and 100% (lamp full ON), in response to receiving a dim command signal.

15. Lamp according to claim 1, comprising at least one sensor (90) for measuring at least one parameter relevant to the operation of the lamp, such as for instance a temperature sensor;

wherein said network element (10) has a sensor input coupled to said sensor for receiving a sensor signal;

the network element (10) being capable of sending a sensor reading signal in response to receiving a lamp status update command.

16. Lamp according to claim 15, wherein the control unit (16) is designed to monitor the sensor signal received from the sensor (90), and to compare the sensor signal with predetermined reference values; the network element (10) being capable of sending a message to a central maintenance post when the comparison indicates a possible abnormality.

17. Street lighting post (20), comprising at least one lamp according to any of the previous claims.

18. Communications network, comprising network entry and exit points communicating with user equipment, and network nodes communicating with each other and with network entry and exit points; wherein at least one network entry point or at least one network exit point or at least one network node comprises a network element (10) of a lamp according to any of the previous claims 1-16, or comprises a network element (10) of a street lighting post (20) according to claim 17.

19. Communications network according to claim 18, capable of functioning as part of a telephone network or part of the Internet or the like.

20. Positioning system, comprising data transmission equipment having an accurately known location, capable of sending data to a receiver, wherein said data transmission equipment comprises at least one lamp according to any of the previous claims 1-16, or comprises at least one street lighting post (20) according to claim 17.

21. Illumination system, comprising a plurality of light sources connected to power supply cables, wherein at least one of said light sources comprises at least one lamp

according to any of the previous claims 1-16, or comprises at least one street lighting post (20) according to claim 17.

ABSTRACT:

A lamp (1), for use in street lighting, is provided with a small network element (10), which preferably is arranged within a lamp fitting (5). The network element is provided with a switching facility, for switching the lamp ON or OFF in response to a corresponding command. The network element is provided with a dimming facility, for dimming the lamp in response to a corresponding command.

The network elements (10) are nodes in a low cost and fast communications network which is quickly to install. The network may provide a fine-mazed and relatively low-cost positioning system.

Fig. 1

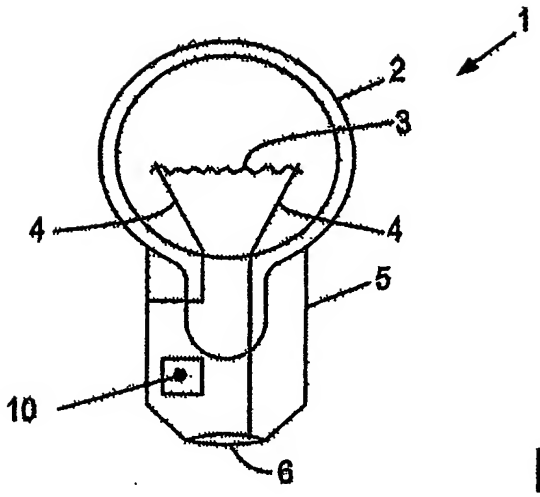

FIG. 1

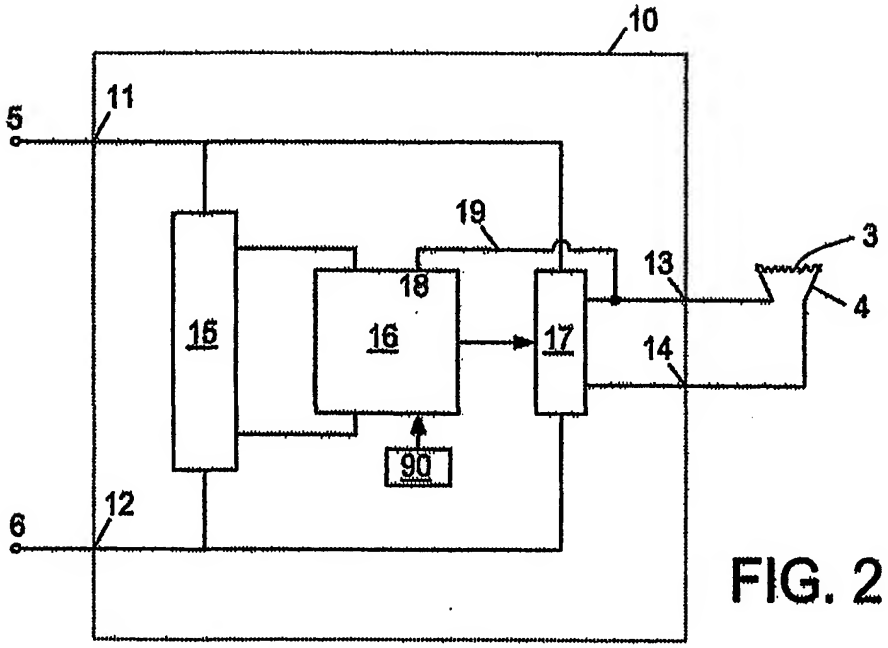

FIG. 2

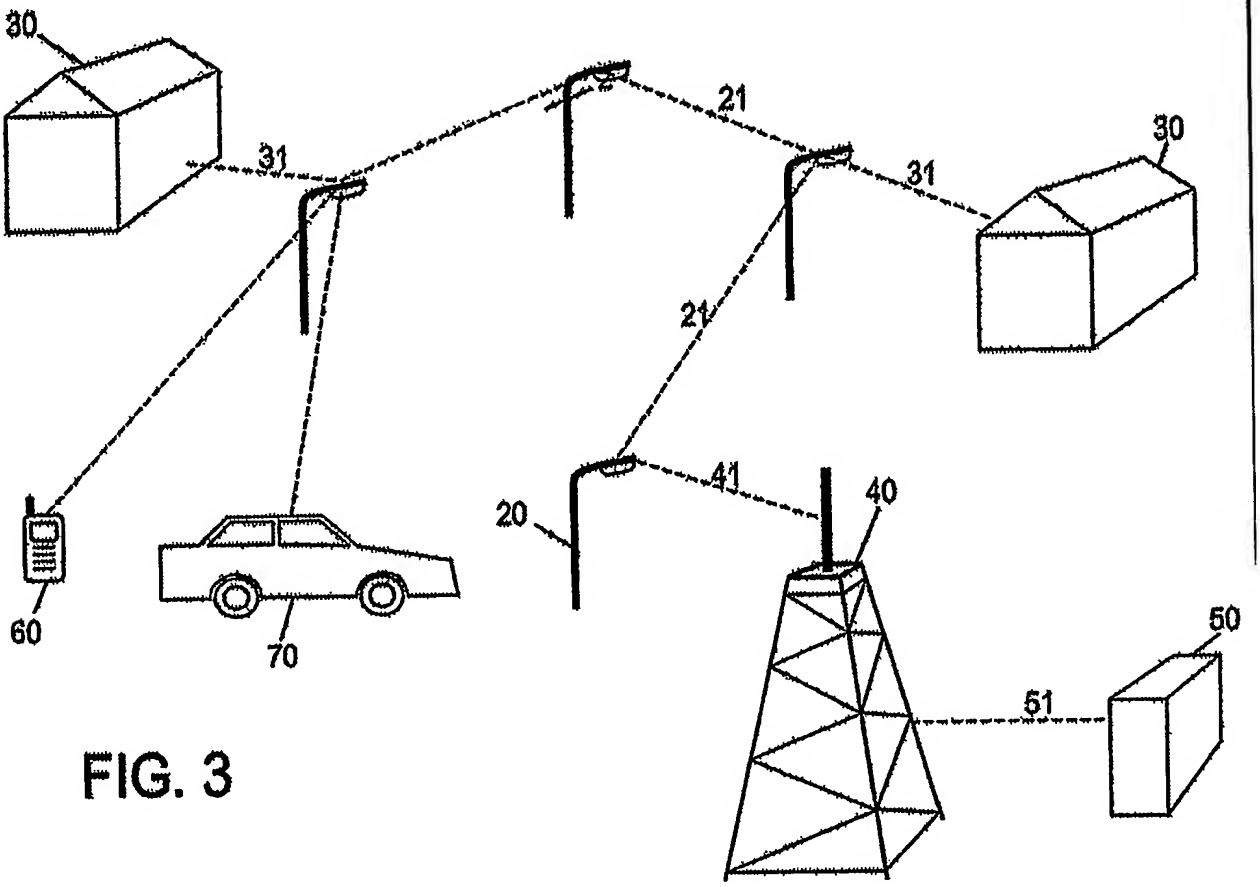

FIG. 3

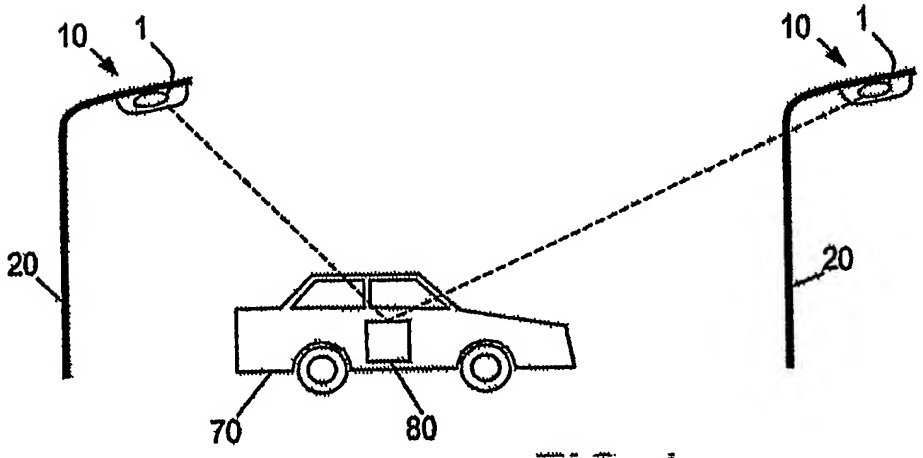

FIG. 4

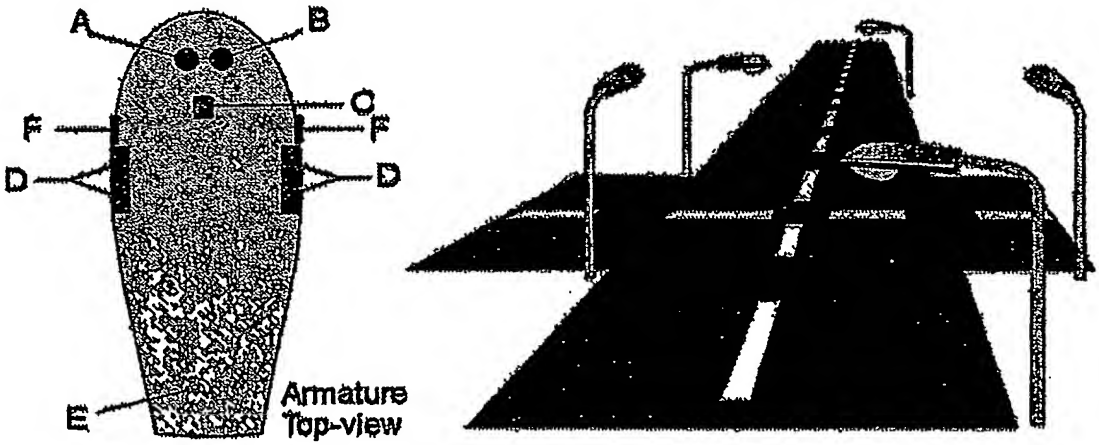

Figure 5

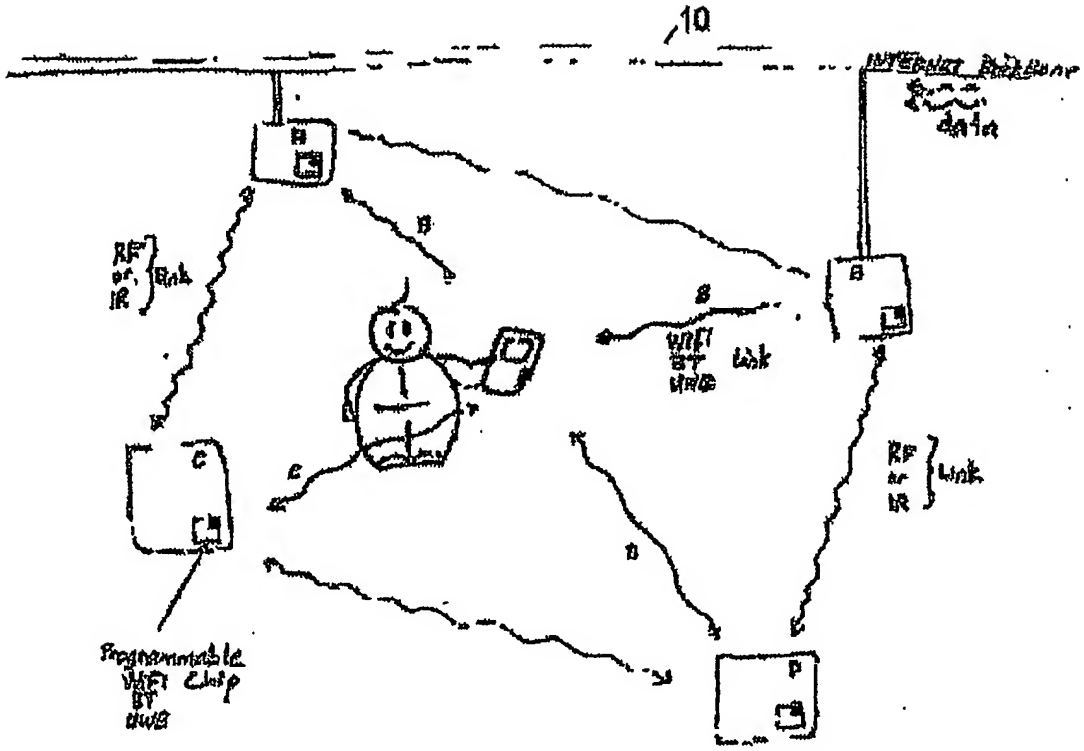

Figure 6

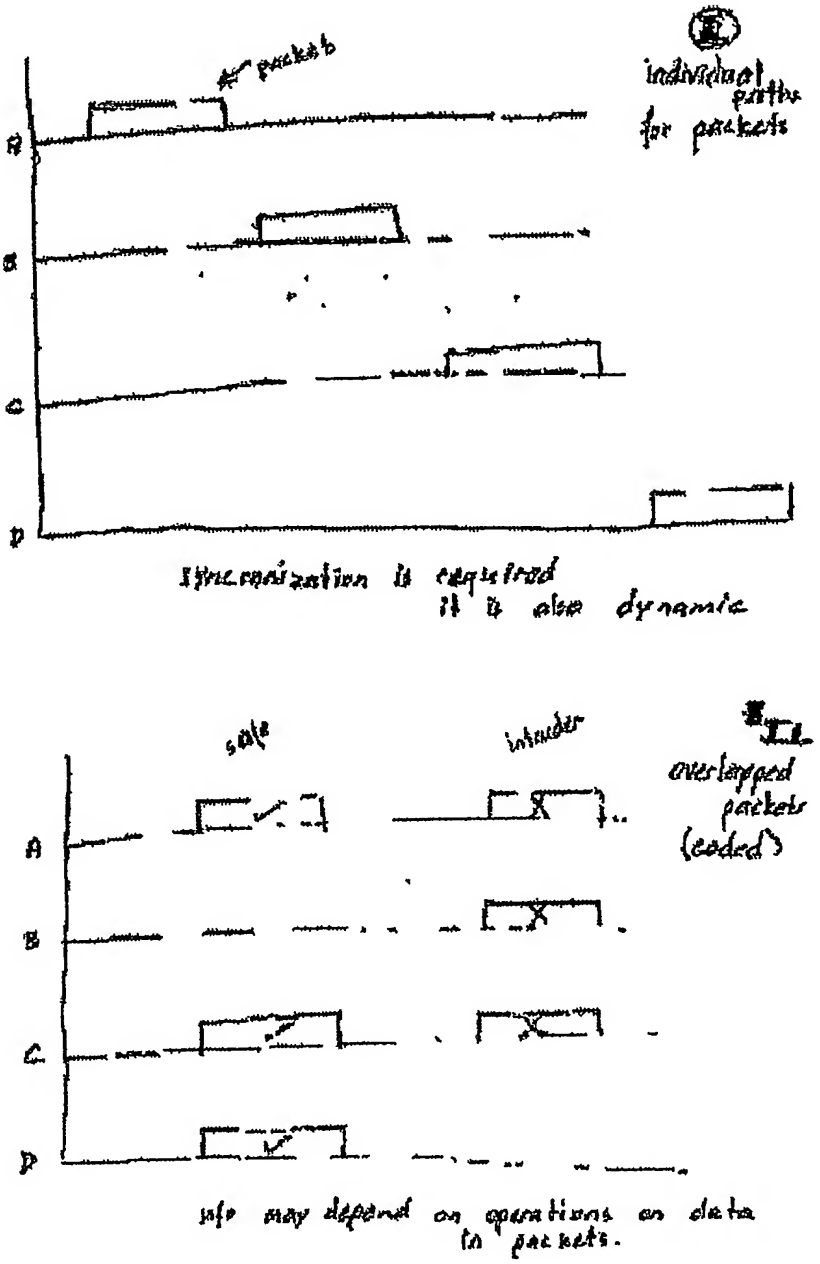
packets
individual paths for packets
A
B
C
D
synchronization is required it is also dynamic
safe
intruder
overlapped packets (coded)
A
B
C
D
info may depend on operations on data in packets.

Figure 7